

Imaging and Simulations of CO Molecular Outflows

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We have mapped the CO J=1-0 emission from molecular outflows associated with 10 young stellar systems of class 0 to class II with BIMA interferometry array and FCRAO single dish. Many of our outflows are closely related to jet like and bow shock structures detected in H₂ or H α emission. The CO emission generally forms a hollowed structure around the jet and bow shock structures. Most of the CO outflows show a nested shell structure with velocity increasing with the distance from the star, but the detailed behavior can vary widely. Here, we presents five outflows to illustrate the different kinematics. Two of them are well described by a single parabolic shell with a Hubble law velocity, consistent with a wide-angle wind driven model. Two of them seem better explained with a jet-driven bow shock model, with a broad range of velocity near the bow shock. The last one appears to have elements of both models.

To better understand the observations and test specific outflow models, we are performing a number of numerical simulations. This poster presents simulations of a jet propagating into a stratified ambient material. In these simulations, the jet-driven bow shock forms a thin cylindrical shell of swept-up gas around the jet, with the velocity vector of the material perpendicular to the shell surface. The simulations produce a wide range of velocity observed near the bow shock, but fail to produce the other CO kinematics in our observations.

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